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U1S S1847

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GB 0895095 A US 5527061 A US 3197233 A

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(54) Stabiliser means for a motor vehicle suspension

(57) In a stabiliser means or anti-roll bar for a vehicle suspension two stabiliser bar sections (3a, 3b) are connected by a rotary connection (5), the sections (3a, 3b) being relatively rotatable about a common axis and each being connected to the rotary connection (5) by a respective mechanical coupling (9, 11). The mechanical couplings (9, 11) each have a pair of mechanically interengaging coupling parts (19, 21) of which one (21) is arranged on the rotary connection (5), and the other (19) on the end of the stabiliser bar section (3a or 3b). The coupling parts (19, 21) have mechanical connecting profiles (15, 17) which, in the unassembled condition, are not wholly complementary, the difference between the profiles being reduced or eliminated on assembly so that a pre-load force acts between the two coupling parts (19, 21). The profiles may be non-aligned splines, differently dimensioned screw threads or face-to-face formations axially clamped together by clamping screws or may be straight splines biased into contact by a wedge or a clamping screw.

Fig. 1

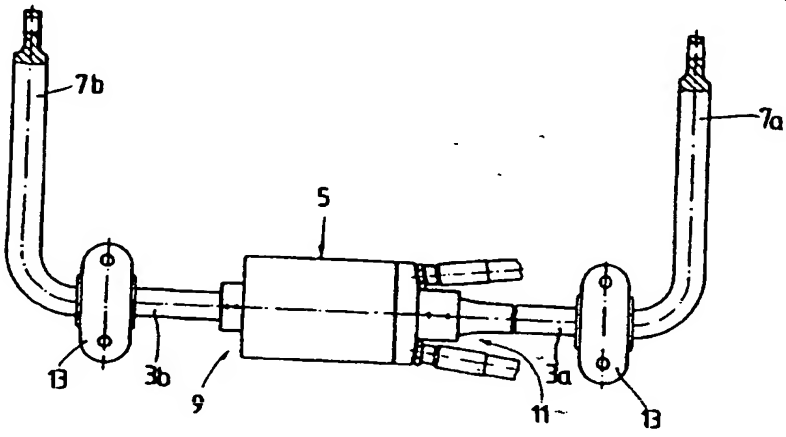
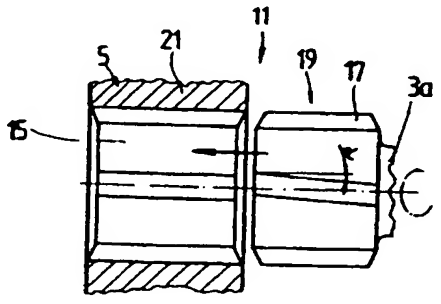


Fig. 2



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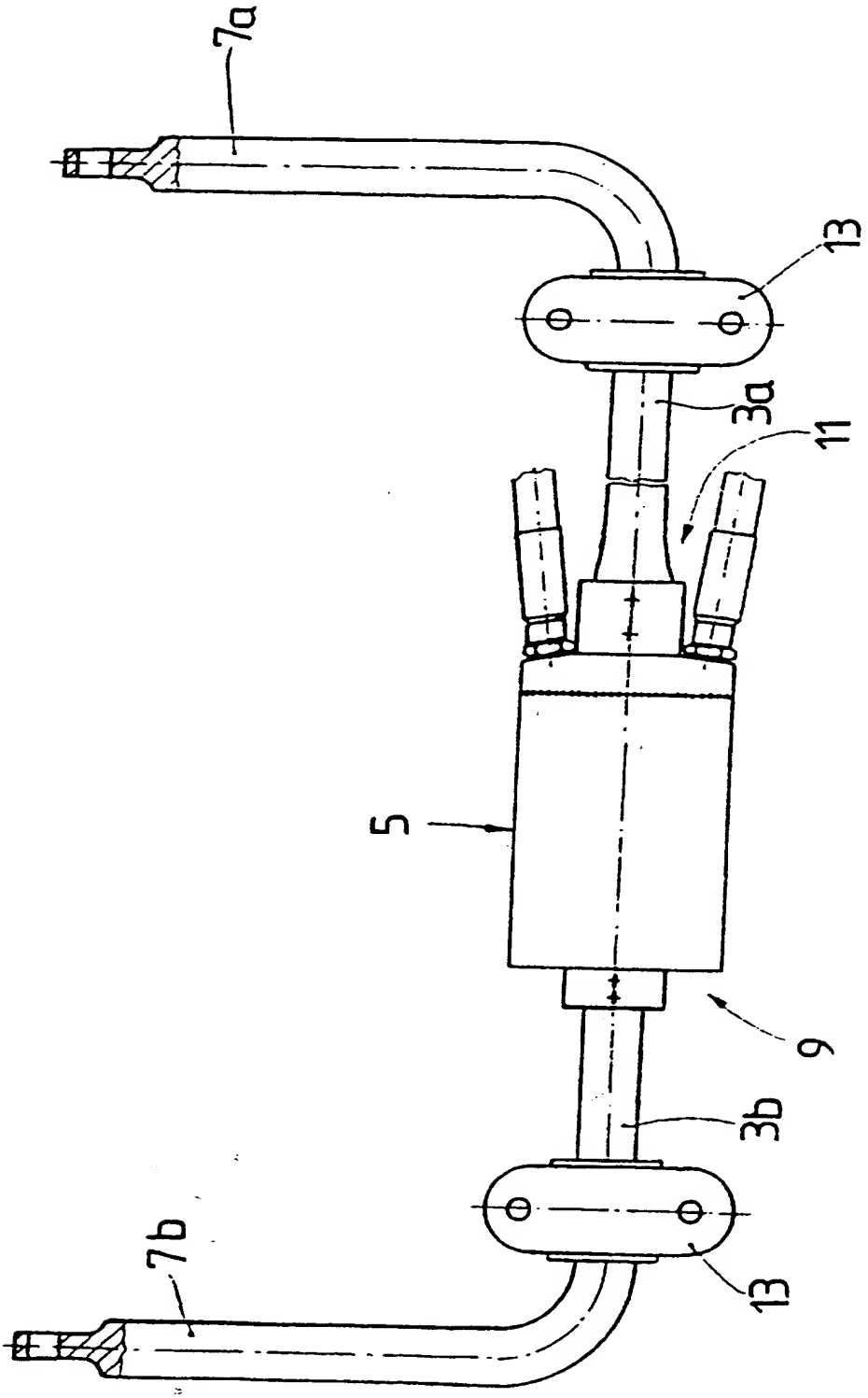


Fig. 1

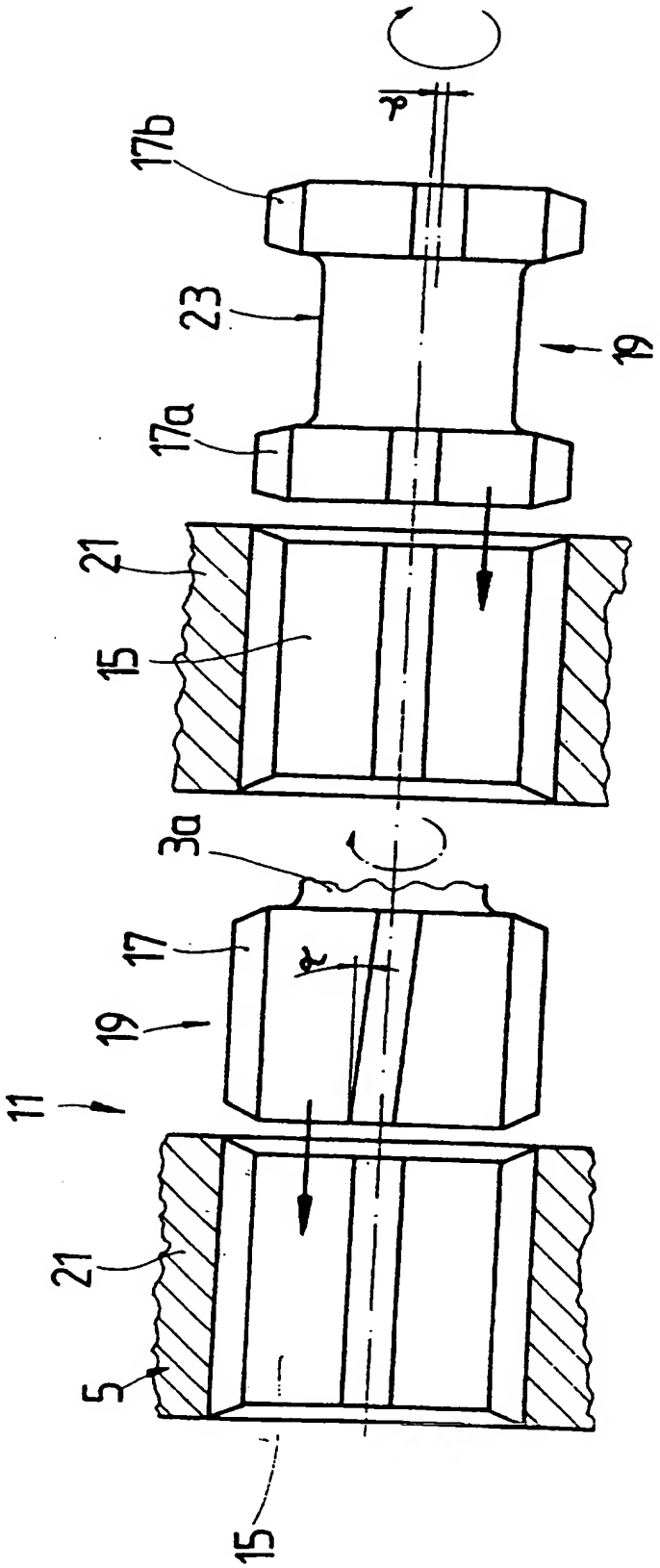


Fig.2

Fig.3

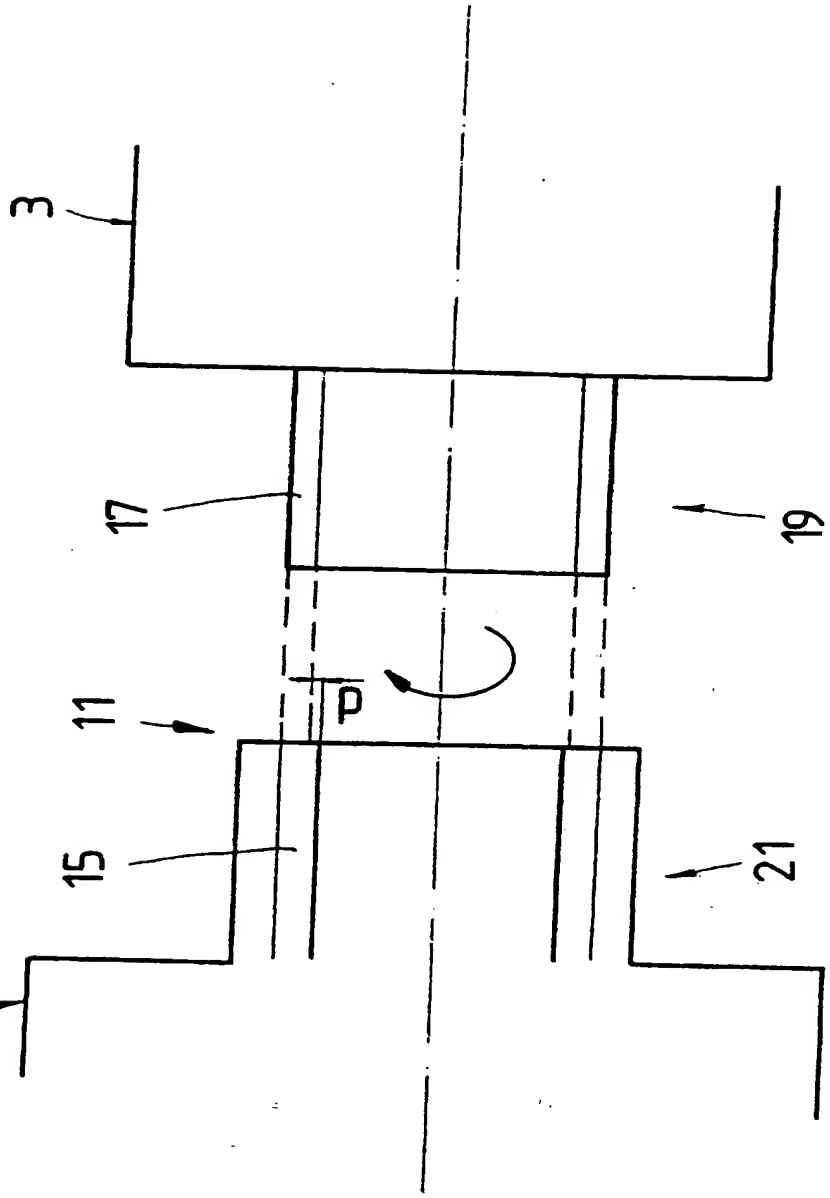


Fig. 4

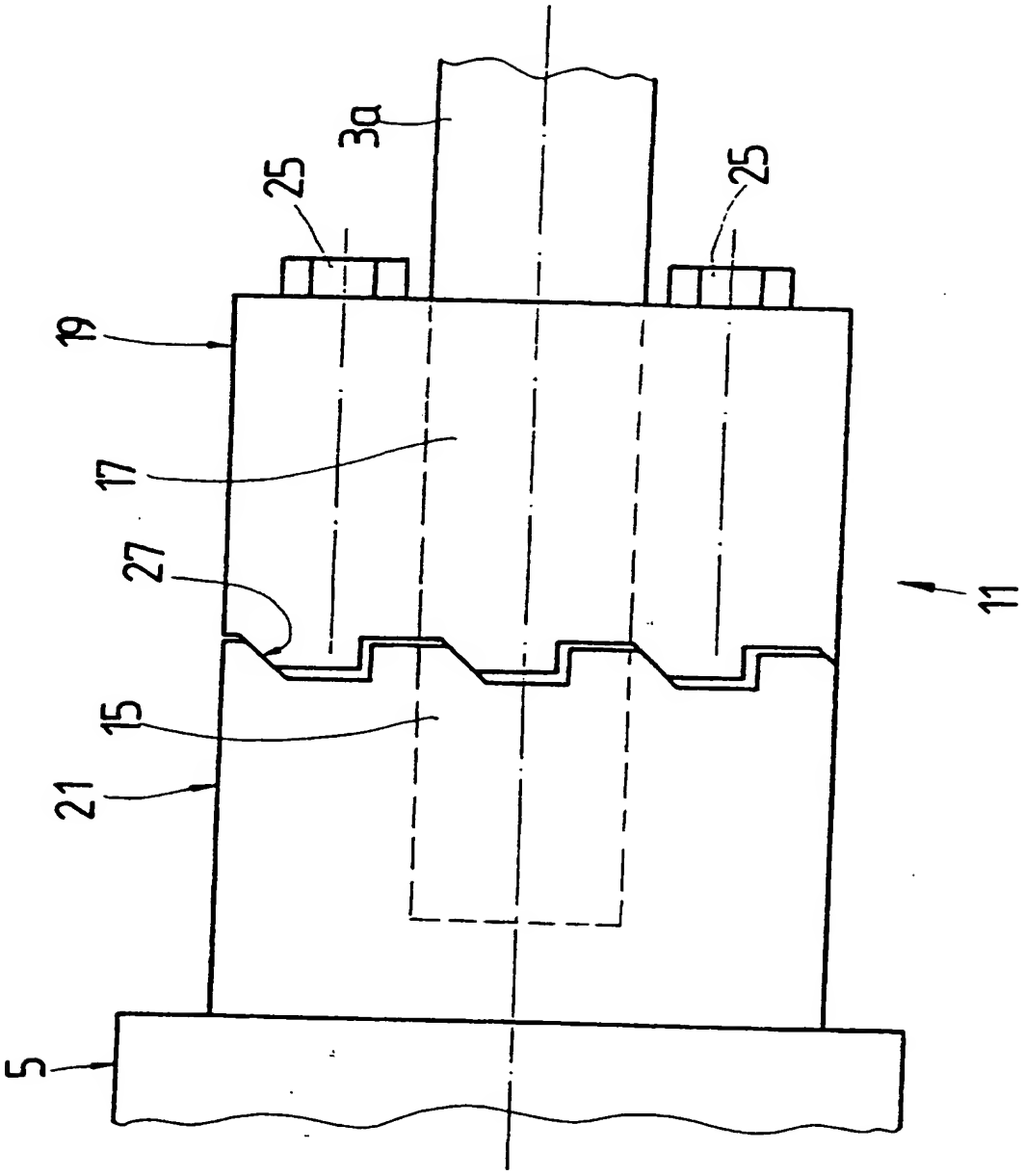


Fig. 5

Fig. 6a

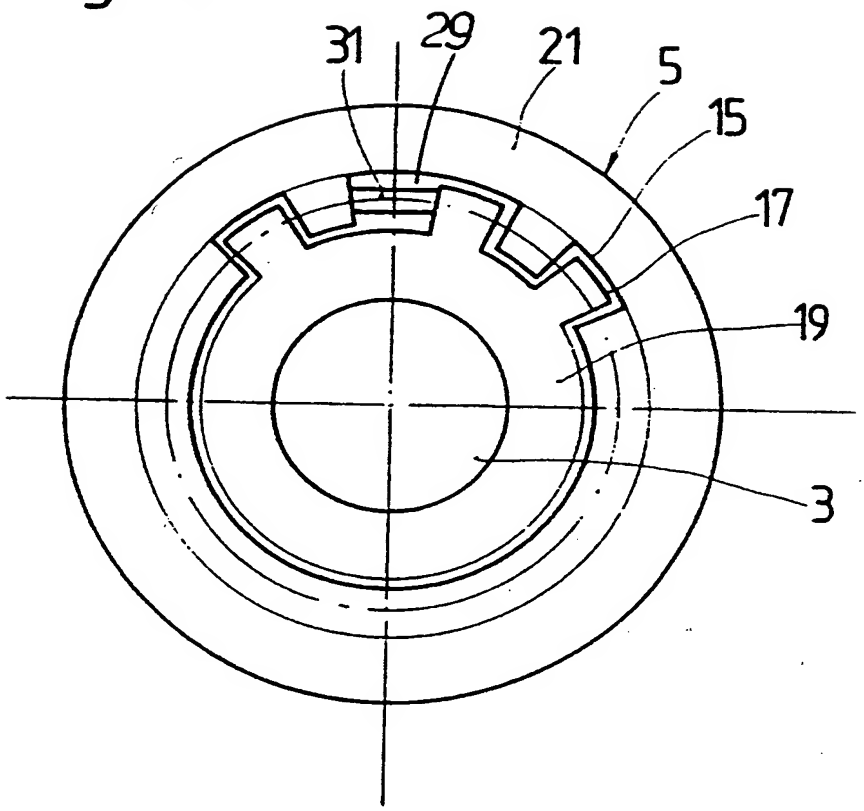


Fig.6b

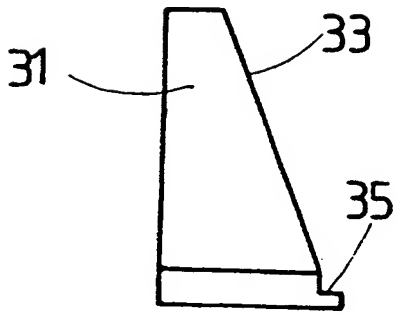


Fig. 6c

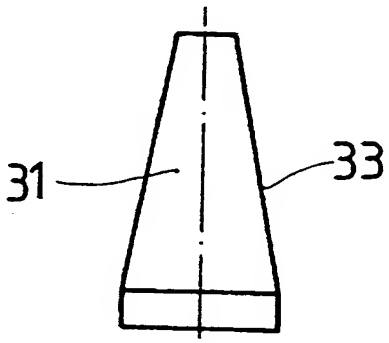


Fig. 7a

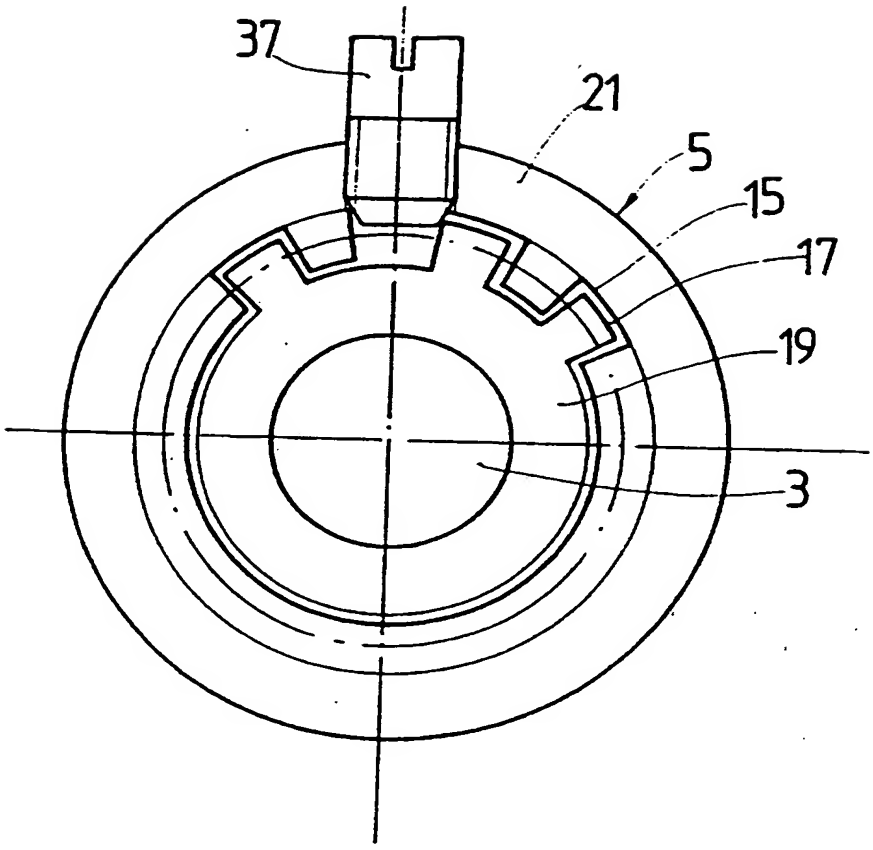
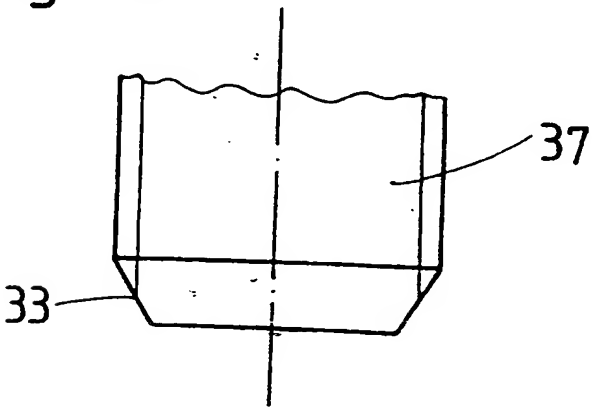


Fig. 7b



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STABILISER MEANS FOR A MOTOR VEHICLE SUSPENSION

The invention relates to a stabiliser means of the kind used in a motor vehicle suspension system comprising a number of wheels, each mounted on a respective wheel carrier and movable relative to the vehicle body by wheel suspension means, the stabiliser means comprising two stabiliser bar sections and a rotary connection between them, the stabiliser bar sections being mounted rotatably relative to the vehicle body about a common axis, each bar section having a crank arm at one end for connection to a respective wheel carrier and being connected at the other end by a mechanical coupling to a connecting portion of the rotary connection, the connecting portions being coaxial with the common axis and rotatable relative to each other, and at least one of the mechanical couplings comprising a pair of mechanically interengaging coupling parts, one arranged on the connecting portion and the other on the end of the stabiliser bar section.

DE-A 41 36 226 shows a stabiliser means of the kind set forth, which reduces or entirely compensates for the rolling movement about the longitudinal axis of the vehicle caused by lateral acceleration when the vehicle is driven in a curved path. The stabiliser means (or anti-roll bar) compensates when the rolling torque tries to lower the vehicle body in relation to the wheel carriers on the outside of the curve and to lift it in relation to the wheel carriers on the inside of the curve. The two wheel carriers, which are associated with the same axis of the vehicle, are connected together through the stabiliser means, which is a split stabilising bar or anti-roll bar. The rotary connection, by means of the relatively rotatable connecting parts, causes a mutually opposite rotary movement of the two crank arms connected to the wheel carriers, and

thereby counteracts the rolling movement of the vehicle body as it tilts during movement of the vehicle in a curve. The rotary connection is in the form of a hydraulic rotating drive. In this stabiliser means, with a split stabiliser bar, the stabiliser bar sections are subjected to a continuous relative movement by the wheel carriers during travel. Because of the clearances in the mechanical couplings, split stabiliser bars tend to be a source of noise and also are exposed to the danger of a high degree of wear.

DE 44 43 809 shows a stabiliser means of the kind set forth, in which mechanical profiles of the mechanically interengaging couplings have their clearances taken up by means of an adhesive introduced into the connection between the profiles. The adhesive practically fills the clearance present within the profile connection. However, such a method requires extreme cleanness in manufacture and relatively tight manufacturing tolerances, and so the stabiliser means is expensive to manufacture.

As an alternative, a slide-in connection for a stabiliser means is known from DE 43 37 771. The slide-in connection is provided by a fork-shaped receiver in conjunction with a slide-in tongue. In this version relatively large changes of shape of the stabiliser bar must be performed in order to form the fork, and the tolerances must be small. This arrangement is also expensive to manufacture if the integrity of the bar is to be maintained.

The invention aims to solve the problem of reducing noise generation in a stabiliser means of the kind set forth with a split stabiliser bar.

According to the present invention, in a stabiliser means of the kind set forth the pair of mechanically interengaging coupling parts have mechanical connecting profiles which, in an unassembled condition, are not wholly complementary, the difference between the profiles being at least partly eliminated in the assembled condition of the coupling parts, to introduce a pre-load force acting through the mechanical connecting profiles, to take up the clearances between the two parts of the coupling.

In this arrangement the pre-load force is greater than the maximum operating load so that the coupling parts are securely assembled, with the clearances taken up. Additional security by means of an adhesive is unnecessary. Moreover, the tolerances of the mechanical connecting profiles can be greater than in the known constructions, since the invention enables greater clearances to be taken-up.

In one preferred arrangement, the mechanical connecting profiles may be brought into operative engagement by means of an elastic deformation of at least one of the mechanical connecting profiles. The elastic deformation produces a reaction force causing relative movement of the mechanical connecting profiles so that any clearances between the two parts of the coupling are adequately taken up.

In another arrangement the mechanical connecting profiles may be brought into operative engagement by means of a plastic deformation of at least one of the mechanical connecting profiles. In this arrangement a deformation of one of the profiles is deliberately produced. The stabiliser arrangement means cannot be taken apart without being destroyed, but this is an advantage, because do-it-yourself constructors cannot carry out unauthorised modifications.

There are several ways that the two coupling parts can be moved for assembly. Thus, the two coupling parts may be assembled by a rotational movement, a translatory movement or a combined movement involving translatory and rotational movement. The nature of the assembly movement results from the particular form of the mechanical connecting profiles.

In one embodiment one coupling part has an internal mechanical connecting profile, and the other part has an external mechanical connecting profile, the mechanical connecting profiles having a different direction of the profile in relation to a common axis. Such coupling parts can be connected to a translatory assembly movement. The same applies to the coupling part having an internal and an external mechanical connecting profile, with the shapes of the profiles being non-complementary.

If the length of the mechanical connecting profiles is substantially equal the support length of the profiles is maximised. Alternatively, at least one mechanical connecting profile of a coupling part can be divided in relation to its direction of assembly. The actual support length of the mechanical connecting profile is then shorter, but the supporting proportion of the support length is greater, so that the permitted load limits are the same. The advantage of a divided or split mechanical connecting profile is that, for the same overall length of the mechanical connecting profile, the machining length for a profiling tool is smaller than for an undivided mechanical connecting profile.

In one embodiment, the coupling parts each have a set of splines as the mechanical connecting profile. The splines may be individual or

multiple splines. A polygonal profile is also to be regarded as one form of splines.

Preferably the splines of at least one of the coupling parts have a profile extending at an angle α with respect to the central axis of the coupling part. Alternatively, the splines on at least one of the coupling parts can have an offset in a circumferential direction.

Alternatively, at least one coupling part has at least one surface inclined to the central axis of the coupling part, the surface forming a mechanical engagement with an opposing surface on the other coupling part, and clamping means being arranged to act between the two coupling parts such that a clamping travel of the inclined surfaces causes a relative rotational movement of the two coupling parts. In this embodiment the coupling parts are slid one into the other without any particular assembly force and then rotated using the clamping means.

In yet another embodiment the two coupling parts may each have a screw thread, the threads differing in at least one of their characteristic dimensions. For example the pitch of the threads can be different or a core thread be oversize or undersize.

In a further embodiment the two mechanical connecting profiles of the coupling parts define a gap into which a wedge is driven. The direction of movement of the wedge may be directed axially or at any desired angle to the line of the mechanical connecting profiles.

Preferably, the wedge has at least one clamping face driven into the gap. The wedge may be conical and then the entire surface forms the

clamping face. The wedge may be provided with a tool face for disassembly.

Alternatively, the wedge with its clamping face is part of a clamping screw. This is a particularly convenient way of applying a force to the wedge.

Various embodiments of the invention are illustrated by way of example in the accompanying drawings, in which:-

Figure 1 illustrates the layout of a stabiliser means of a motor vehicle suspension system; and

Figures 2 - 7 show various embodiments of a mechanical coupling for connecting a stabiliser bar section to a rotary connection.

Figure 1 shows a stabiliser means or anti-roll bar 1 with a split stabiliser bar 3a, 3b, of which the two sections are coupled together by means of a rotary connection 5. The rotary connection may be a pivoting motor or a passive dog clutch.

The stabiliser means 1 is used in a vehicle suspension system (not shown) having wheels mounted on wheel carriers and movable relative to the vehicle body by suspension means. Each stabiliser bar section 3a, 3b has a crank arm 7a, 7b respectively connected to a wheel carrier (not shown). The other ends of the bar sections 3a, 3b are connected by mechanical couplings 9, 11 to the rotary connection 5. The couplings 9, 11 each have a pair of mechanically interengaging coupling parts, one arranged on a connecting portion of the rotary connection 5 and the other on the end of the stabiliser bar section 3a, 3b. The sections 3a, 3b of the

stabiliser form a self-contained structural unit with the rotary connection 5. The overall stabiliser unit 1 is connected through rotary pivots 13 to a vehicle body, likewise not shown. The manner of operation of a stabiliser of anti-roll bar is assumed to be known.

Figures 2 to 7 show the detailed construction of the coupling parts.

Figure 2 shows a mechanical interengaging coupling 11 in which the two coupling parts 19, 21 each have a mechanical connecting profile 15, 17 formed by longitudinal splines. The exact geometric shape of the mechanical profile is not critical. What is important is the fact the the mechanical profiles 15, 17 of the stabiliser section 31 and the rotary connection 5 are not wholly complementary, and how they differ from one another. In this embodiment the difference lies in the form of an inclined position of at least one tooth of the mechanical profile 17 at an angle α to the longitudinal axis of the coupling part 19 of the mechanical coupling.

On assembly the coupling part 19 for the section 3a of the stabiliser bar is pressed into the housing of the rotary connection 5 axially with a translatory movement into the coupling part 21. The pre-load produced by the difference between the mechanical connecting profiles 15, 17 urges the two parts of the coupling together to take up any clearances. The pre-load force is always greater than the maximum operating load which arises. It will be noted that the entire length of both profiles 15, 17 forms the supporting portion of the mechanical interengagement.

The embodiment of Figure 3 is similar to that of Figure 2, but the mechanical connecting profile 17 is divided by a free shank 23 into first and second portions 17a, 17b of the profile. The two portions 17a, 17b of the mechanical connecting profile 17 are offset circumferentially by the

angle α. On assembly, first the portion 17a is inserted axially into the profile 15 until the portion 17b of the profile "nudges" with its leading edge against the coupling part 21. Then a rotational movement in a direction against the angle α is applied, which turns the mechanical connecting profile portion so that the other part 17b of the profile 17 can be inserted. The advantage of this embodiment is that it uses a simple profiling tool. For example the coupling part 19 can be produced as a forged blank having the outside diameter of the profile 17. In a subsequent working step the shank 23 is produced, for example by a turning operation, resulting in the two mechanical profile portions 17a; 17b. The actual profile can then be formed in one portion using a milling cutter. When all the teeth have been cut, the milling cutter or the blank can be turned through the angle α in order to form the other portion. It is true that support length of the profile is shorter that that of Figure 2, but the supporting proportion of the support length within the mechanical coupling is significantly higher.

The embodiment of Figure 4 differs from that of Figures 2 and 3 in that the mechanical connecting profiles 15, 17 comprise screw threads. However, the threads are not complementary, as there is a difference in dimension d formed by the root diameter of the profile 17. This results in an oversize of the profile 17 which causes a pre-load which again takes up any clearances between the parts 21 and 19 of the coupling. The difference between the dimensions of the threads can be chosen to produce an elastic or a plastic deformation of one or both parts of the coupling, to produce the pre-load force. It will be understood that the difference could be in the pitches of the thread of any other characteristic dimension. On assembly the two parts 19, 21 of the coupling which are to be joined together are rotated relative to one another.

The embodiment of Figure 5 shows the two profiles 15, 17 of the coupling parts 19, 21 of toothed form and engaging face-to-face. The profiles 15, 17 each have inclined faces 27. Clamping means in the form of axial clamping screws 25 apply an axial clamping movement to the parts, which is converted into a rotational movement by the surfaces 27. The rotational movement takes up any clearances between the mechanical connecting profiles 15, 17. The clearance between the two mechanical connecting profiles can be quite substantial. Moreover, the initial assembly takes place without any force being applied. Only on the application of the tightening torque to the clamping means is a pre-load generated.

Figure 6a shows an embodiment in which the two mechanical connecting profiles 15, 17 are splined. The profiles 15, 17 are complementary apart from a gap 29 between the two coupling parts 19, 21. Straight splines can be provided as the profile as these are simple to manufacture. For assembly, a wedge 31 (see Figure 6b) with at least one clamping surface 33 is driven into the gap 29. The clamping surface 33 is in the form of an oblique plane so that an axial movement of the wedge in conjunction with the splines of the mechanical profiles 15, 17 causes rotational movement of the two coupling parts 19,21. In a modification (see Figure 6c) a circular conical wedge 31 is used to move the two coupling parts 19,21 circumferentially and radially to clamp them and take up the clearances. On assembly, the two coupling parts 19, 21 are positioned in an axial direction within a device, not shown, so that the spacing between the crank arms 7a, 7b is defined. The wedge 31 is then driven into the gap 29. The device ensures that no assembly forces are introduced into the interior of the rotary connection 5. For disassembly a tool face 35 (Figure 6b) is provided on the wedge 31, capable of being engaged by a pulling-off tool.

Figure 7 shows an alternative to Figure 6, in which a clamping screw 37 is used instead of a wedge 31. The screw 37 has a clamping face 33 (see Figure 7b) at its forward end. With increasing adjusting movement the clamping face 33 co-operates with the two mechanical connecting profiles 15, 17, to produce a relative rotational movement between the two coupling halves 19, 21 and a radial movement to take up the clearances. In the example shown in Figures 6 and 7 no assembly force is needed to bring together the two coupling parts. Force is only applied to the clamping means to produce the clamping action and pre-load force.

CLAIMS

1. A stabiliser means of the kind set forth, in which the pair of mechanically interengaging coupling parts have mechanical connecting profiles which, in an unassembled condition, are not wholly complementary, the difference between the profiles being at least partly eliminated in the assembled condition of the coupling parts, to introduce a pre-load force acting through the mechanical connecting profiles, to take up the clearances between the two parts of the coupling.

2. A stabiliser means as claimed in claim 1, in which the mechanical connecting profiles are brought into operative engagement by means of an elastic deformation of at least one of the mechanical connecting profiles.

3. A stabiliser as claimed in claim 1, in which the mechanical connecting profiles are brought into operative engagement by means of a plastic deformation of at least one of the mechanical connecting profiles.

4. A stabiliser means as claimed in any preceding claim, in which the two coupling parts are assembled by a rotational movement.

5. A stabiliser means as claimed in any of claims 1 to 3, in which the two coupling parts are assembled by a translatory movement.

6. A stabiliser means as claimed in any of claims 1 to 3, in which the two coupling parts are assembled by a combined movement involving translatory and rotational movement.

7. A stabiliser means as claimed in any preceding claim, in which one coupling part has an internal mechanical connecting profile, and the other

coupling part has an external mechanical connecting profile, the mechanical connecting profiles having a different direction of the profile in relation to a common axis.

8. A stabiliser means as claimed in any of claims 1 to 6, in which one coupling part has an internal mechanical connecting profile, and the other coupling part has an external mechanical connecting profile, the shapes of the profiles being non-complementary.

9. A stabiliser means as claimed in any preceding claim, in which the length of the mechanical connecting profiles of the coupling parts is substantially equal.

10. A stabiliser means as claimed in any of claim 1 to 8, in which at least one mechanical connecting profile of a coupling part is divided in relation to its direction of assembly.

11. A stabiliser means as claimed in any preceding claim, in which the coupling parts each have a set of splines as the mechanical connecting profile.

12. A stabiliser means as claimed in claim 11, in which the splines of at least one of the coupling parts have a profile extending at an angle α to the central axis of the coupling part.

13. A stabiliser means as claimed in claim 11, in which the splines of at least one of the coupling parts have an offset in a circumferential direction.

14. A stabiliser means as claimed in any of claims 1 to 3, in which at least one coupling part has at least one surface inclined to the central axis of the coupling part, the surface forming a mechanical engagement with an opposing surface on the other coupling part, and clamping means being arranged to act between the two coupling parts such that a clamping travel of the inclined surface causes a relative rotational movement of the two coupling parts.

15. A stabiliser means as claimed in any of claims 1 to 3, in which the two coupling parts each have a screw thread, the threads differing in at least one of their characteristic dimensions.

16. A stabiliser means as claimed in any of claims 1 to 3, in which the two mechanical connecting profiles of the coupling parts define a gap into which a wedge is driven.

17. A stabiliser means as claimed in claim 16, in which the wedge has at least one clamping face driven into the gap.

18. A stabiliser means as claimed in claim 16 or claim 17, in which the wedge is provided with a tool face for disassembly.

19. A stabiliser means as claimed in any of claims 16 to 18, in which the wedge with its clamping face forms part of a clamping screw.

20. A stabiliser means of the kind set forth substantially as described herein with reference to and as illustrated in Figures 1 and 2 of the accompanying drawings.

21. A stabiliser means of the kind set forth substantially as described herein with reference to and as illustrated in Figure 3 of the accompanying drawings.

22. A stabiliser means of the kind set forth substantially as described herein with reference to and as illustrated in Figure 4 of the accompanying drawings.

23. A stabiliser means of the kind set forth substantially as described herein with reference to and as illustrated in Figure 5 of the accompanying drawings.

24. A stabiliser means of the kind set forth substantially as described herein with reference to and as illustrated in Figure 6 of the accompanying drawings.

25. A stabiliser means of the kind set forth substantially as described herein with reference to and as illustrated in Figure 7 of the accompanying drawings.

Patent Office

15

Application No: GB 9701607.5 **Examiner:** C J Duff
Claims searched: 1 - 25 **Date of search:** 8 April 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B7D(DCB), F2U

Int Cl (Ed.6): B60G 21/10, 21/055; F16D 1/00, 1/06, 1/064, 1/072, 1/08, 1/09, 1/12

Other: On-line: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2030269 A	(ROLLS-ROYCE) Whole document	1-9, 11,12,14
Y	GB 1132649	(DAVID BROWN) Whole document	1-3,5,8, 11,16,17
Y	GB 0989997	(PACIFIC) Whole document	1-6,9,11
Y	GB 0895095	(DAIMER-BENZ) Figs 1-3	1-9,11,12, 14,16,17
Y, P	US 5527061	(KARL) Whole document	1-9,11,12, 14,16,17
Y	US 3197233	(VAN WINSEN) Figs 1-4	1-9,11,12, 14,16,17

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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